Design and Development of a Next Generation High Capacity, Light Weight, 20 K Pulse Tube Cryocooler for Active Thermal Control on Future Space Exploration Missions

Completed Technology Project (2013 - 2016)

Project Introduction

For future NASA exploration missions, such as propulsion stages for long duration missions to asteroids or Mars, the storage time of cryogenic propellants must extend beyond half a day to multiple years in order to enable projected applications. For these missions to be successful, cryogenic temperatures down to 20 K must be achieved, while maintaining high heat capacities of 5 W or higher. This would be a signification leap from current state of art, and would lead to accomplishing near-zero boil-off rates for propellant cryogens. We will develop a cryocooler that accomplishes these goals, while also being light-weight, low vibration, long-lasting, and efficient. This novel cryocooler will progress the thermal control technology area, and will be a contribution towards reliably and efficiently enabling long duration storage of cryogenic systems, specifically for the long-term storage of hydrogen. The cryocooler will be suitable for integration into thermal control system approaches for future mission architectures, spacecraft, and operations.

Anticipated Benefits

This project is designing and developing a cryocooler potentially suitable for integration into thermal control system approaches for future mission architectures, spacecraft, and operations. For future NASA exploration missions, such as propulsion stages for long duration missions to asteroids or Mars, the storage time of cryogenic propellants must extend beyond half a day to multiple years in order to enable projected applications. For these missions to be successful, cryogenic temperatures down to 20 K must be achieved, while maintaining high heat capacities of 5 W or higher. This would be a signification leap from current state of art, and would lead to accomplishing near-zero boil-off rates for propellant cryogens.

Project Image Design and Development of a Next Generation High Capacity, Light Weight, 20 K Pulse Tube Cryocooler for Active Thermal Control on Future Space Exploration Missions

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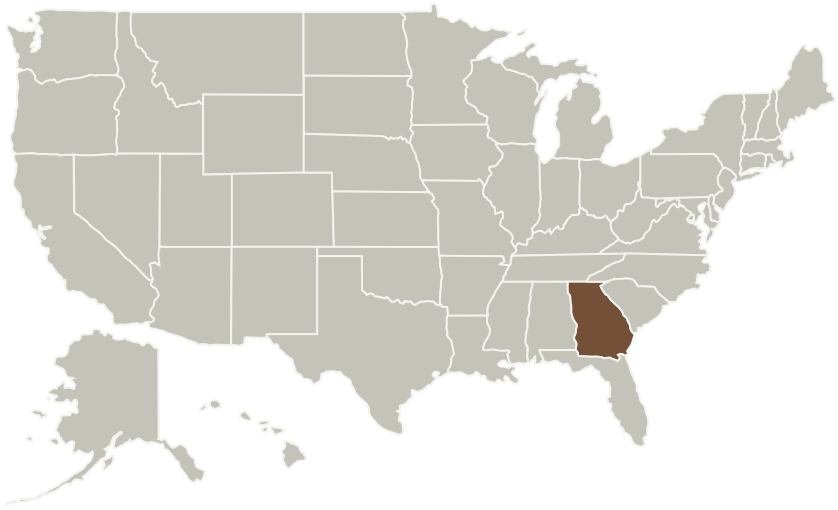
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Georgia Institute of Technology-Main Campus(GA Tech)	Supporting Organization	Academia	Atlanta, Georgia

Primary U.S. Work Locations
Georgia

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

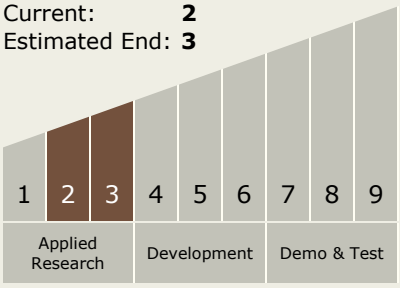
Hung D Nguyen

Principal Investigator:

Seyed Ghiaasiaan

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



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Images

11957-1363016742505.jpg
Project Image Design and Development of a Next Generation High Capacity, Light Weight, 20 K Pulse Tube Cryocooler for Active Thermal Control on Future Space Exploration Missions
(https://techport.nasa.gov/image/1685)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.1 In-space Propellant Storage & Utilization